Tracking Oil Spills with Coastal Drifters

When oil spills, responders ask: "Where is it going to go?" and "How fast will it get there?"Under the National Contingency Plan, the role of NOAA's Hazardous Materials Response Division (HAZMAT) is to provide scientific advice on the behavior and movement of spilled oil and hazardous chemicals in U.S. navigable waters.

One of HAZMAT's specialties is forecasting the trajectory of spilled oil. When requested to forecast a spill's trajectory, HAZMAT quickly assembles preliminary information about the incident. Initial phone calls are made to NOAA's National Weather Service. Local experts, often other government scientists or academic researchers, are asked to provide oceanographic insight for the particular spill area.

Real-time environmental data as well as oil slick observations also are crucial if a spill trajectory forecast is to be accurate. To enhance meteorological and on-scene spill observations and oil spill forecasting efforts, HAZMAT may deploy satellite-tracked surface buoys, or "drifters." The drifters deployed by HAZMAT are sturdy enough to be deployed from a helicopter at about 75 feet, yet are light enough to be transported by winds and currents in the general direction of movement of an oil slick. Because each drifter transmits its geographic position via satellite, an aircraft or boat is not needed to find its location. If a drifter unexpectedly changes direction (drifters are sometimes picked up by boaters), HAZMAT's trajectory forecasting team is quickly alerted and corrections are made to the forecast if needed.

A drifter transmits its position for 30 days at a resolution of 1 kilometer. Generally, the time scale of the spill determines how long data from the drifter will remain relevant. Eventually, the drifter may no longer represent oil movement. Even then, it may still provide information on water movement that could prove useful during a future incident.

However, difficulties complicate the use of drifters in many situations. In particular, it's difficult to select a drifter to track a spill for a long period of time because both drifter buoys and spilled oil can change in their drift characteristics over time, in quite different ways:

- The drift characteristics of a buoy can change unpredictably over time as small marine creatures attach to it.
- The physical characteristics of spilled oil can change dramatically over time, altering the oil's drift characteristics. Initially, spilled oil forms a large, cohesive slick, about as thick as a strand of hair, which is transported by winds and currents at about 3 to 4 percent of the wind speed. As time passes, winds and currents tear the slick into smaller patches. Depending on the type of oil spilled, water can be entrained into the slick to form an emulsion, which can contain up to 70 percent oil and can be as thick as peanut butter. Such emulsified oil can form into thick patties that continue to be torn into smaller pieces, called tarballs. Although tarballs are lighter than water, breaking waves can push them down into the water column for short periods of time, much as waves bob a cork. Because tarballs are below the surface and unaffected by wind much of the time, they may drift as slowly as 1 to 2 percent of the wind speed.

It's particularly difficult to select drifters to represent tarball movement, because turbulence can eventually spread tarballs over a very large area, sometimes up to hundreds of square miles. Just a few drifters generally can't accurately represent tarballs distributed over a very wide geographic area.

In certain cases, though, drifters can provide useful clues about the movement of spilled oil. Most important, when fog or storms prevent trained observers from making overflights of the area of a spill to track the oil, drifters can be deployed to provide an indication of the spill's trajectory that otherwise would be lacking. Also, sometimes researchers suspect the presence of a convergence zone (a line on the water surface where floating objects and oil collect). In those cases, drifters can be used to find the zone: they, like the oil, will collect within the zone, where they indicate its presence. Once the location of a convergence zone has been identified, skimmers or other cleanup devices can be dispatched to the area to pick up the collected oil.

Drifter buoys will remain an important spill response tool for HAZMAT's response specialists, one that can't be used effectively in many situations, but that can be very useful in others.

For additional information about oil spill response, visit http://response.restoration.noaa.gov/oilaids.html.

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